Keysight Technologies
Mobile WiMAX™ X-Series Measurement App, Traditional UI N9075EM0D

Technical Overview

- Mobile WiMAX™ RF transmitter measurements
- Single-channel matrix A modulation analysis and pilot-based matrix B (wave 2) analysis
- One-button tests with pass/fail limits per Mobile WiMAX standard
- Hardkey/softkey manual user interface and SCPI remote user interface
- Built-in context sensitive help
- Flexible licensing provides the option of using perpetual or time based licenses with one or multiple signal analyzers

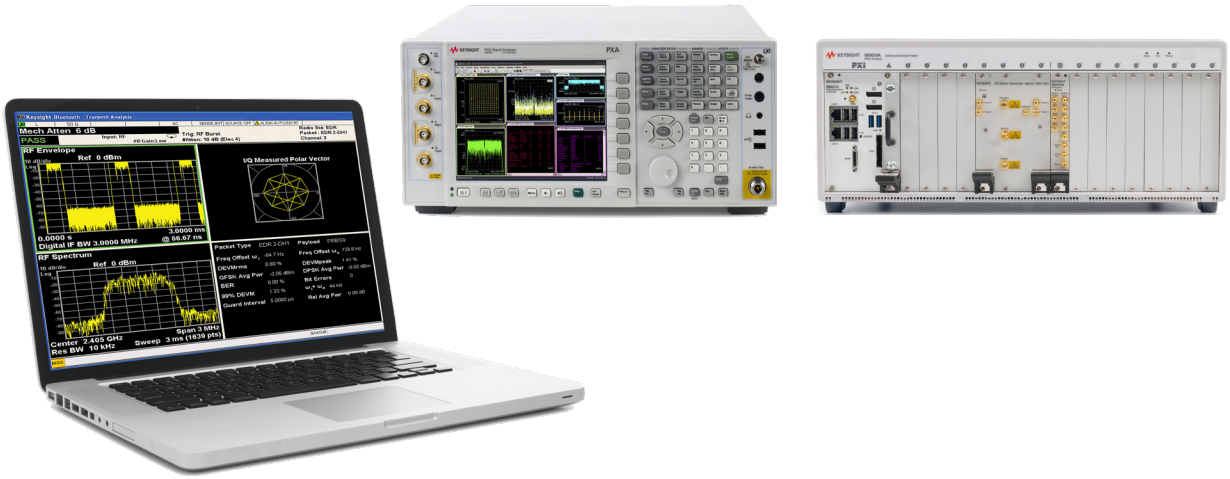
KEYSIGHT TECHNOLOGIES

Mobile WiMAX Measurement Application

The Mobile WiMAX measurement application transforms the X-Series signal analyzers into standard-based Mobile WiMAX transmitter testers by adding fast one-button power and modulation measurements to help you design, evaluate, and manufacture your Mobile WiMAX devices, based on IEEE 802.16e-2005 and WiBro. When the Keysight Technologies, Inc. N9030A PXA or N9020A MXA signal analyzer has optional baseband IQ inputs, Option BBA, each of the RF and analog baseband IQ signals of Mobile WiMAX can be measured to compare signal quality.

X-Series measurement applications can help you:

- Gain more insight into device performance with intuitive display and graphs for your application. Select from our library of over 25 different measurement applications.
- Ensure that your design meets the latest standard. Updates are made to the X-Series measurement applications as standards evolve.
- Apply the same measurement science across multiple hardware platforms for consistent measurement results over your design cycle from R&D to production.
- Choose the license structure that meets your business needs. We provide a range of license types (node-locked, transportable, floating or USB portable) and license terms (perpetual or time-based).



Mobile WiMAX Overview

The IEEE 802.16e-2005 standard, often referred to as Mobile WiMAX, defines the physical layer (PHY) and medium access control (MAC) protocol for products that extend broadband wireless access (BWA) from the local area network (LAN) to the metropolitan area network (MAN). The standard contains specifications for licensed and unlicensed BWA operating between 2 and 11 GHz. The term OFDMA used to describe this new technology means orthogonal frequency division multiple access and it distinguishes the system from OFDM technologies such as Fixed WiMAX or 802.11 WLAN. The standard includes an OFDMA PHY layer with sub-channelization that allows the time and frequency resources to be dynamically allocated among multiple users across the downlink (DL) and uplink (UL) sub-frames. It uses a combination of TDD and OFDMA for downlink and uplink signaling and multiple user access. The unique features within the TDD/OFDMA frame provide frequency diversity, frequency reuse, and cell segmentation which improve the performance against fading and inter-cell interference.

For data transmission the standard defines a set of adaptive modulation and coding rate configurations that can be used to trade off data rate for system robustness under various wireless propagation and interference conditions. When the radio link quality is good, the WiMAX system can use a higher-order modulation scheme (more bits/symbol) that will result in more system capacity. When link conditions are poor due to problems such as signal fading or interference, the WiMAX system can change to a lower modulation scheme to maintain an acceptable radio link margin. The allowed modulation types are binary phase shift keying (BPSK), quadrature phase shift keying (QPSK), 16 quadrature amplitude modulation (16QAM), and 64QAM.

The WiMAX Forum™ is comprised of industry experts whose charter is to bring the IEEE 802.16 standard to the marketplace and to create the process for certification and inter-operability between equipment vendors. The WiMAX Forum tests operational performance based on the standard through the use of radio and protocol conformance test documentation. Subsets of system features are known as profiles, which specify the mandatory and optional features from the 802.16 standard required for baseline functionality and interoperability. The choice of profiles has been driven by spectrum availability, regulatory constraints, and market demand. The WiMAX Forum specifies a series of protocol and radio conformance tests (RCT) for compliance and interoperability between various equipment manufacturers. Certification test houses, such as AT4 Wireless in Spain and Telecommunications Technology Association (TTA) in Korea, were among the first to be approved by the WiMAX Forum to provide conformance testing to the WiMAX profile specifications.

In order to support increased range, link reliability, and throughput, several advanced features are supported in wave 2. These include DL/UL adaptive modulation and coding (DL/UL AMC zones), beamforming, space time coding (STC) or matrix A, 2x2 MIMO with vertical encoding or matrix B, and collaborative spatial multiplexing-uplink (CSM). The use of 2 antennas for transmission and 1 for reception gives the notation 2x1, and the use of 2 antennas for transmission and 2 for reception gives the notation 2x2. Matrix A and matrix B zones may be transmitted by a base station with two transmit antennas. In the downlink subframe, the preamble is followed by the first zone–a mandatory PUSC zone that contains the FCH, the DL-MAP, and the UL-MAP. The preamble and first zone are transmitted only by antenna 0. Antenna 1 is generally expected to be inactive during this time, but becomes active with the first matrix A or matrix B zone in the subframe.

RF Transmitter Tests

The X-Series signal analyzers along with the Mobile WiMAX measurement application, perform transmitter measurements on BS and MS devices in time, frequency and modulation domains. Mobile WiMAX signals with zone types PUSC, FUSC, OPUSC, OFUSC, and AMC can be analyzed. Additionally, modulation analysis can be done on matrix A signals and pilot-based modulation analysis can be done using a single input on matrix B signals.

Standard-based RF transmitter tests

The RF transmitter test and air interface requirements for product certification of base stations and mobile devices by the WiMAX Forum are defined in the WiMAX Forum Mobile Radio Conformance Test and additional requirements for mobile stations are defined in the WiMAX Forum Mobile Radio Requirement Testing. Table 2 shows the required base station RF transmitter tests along with the corresponding measurement applications. Note some MS tests require the use of a base station emulator (BSE) and some BS tests require the use of a mobile station emulator (MSE). This aspect is not included in the tables.

Table 1. Required mobile station transmitter measurements and the corresponding measurements in N9075EM0D and 89601B-B7Y.

RCT test #	Transmitter test	N9075EM0D 802.16 OFDMA measurement (WiMAX/WiBro)	89601B-B7Y 89601B for mobile and fixed WiMAX
MS-12.1	MS transmitter modulation and coding, cyclic prefix and frame duration timing	Modulation analysis	EVM
MS-13.1	MS transmit ranging support	Transmit power	Can be performed using band power marker
MS-15.1	MS transmit power dynamic range and relative step accuracy	Channel power	Can be performed using band power marker
MS-16.1	MS transmit power control support	Channel power	Can be performed using band power marker
MS-17.1	MS transmitter spectral flatness	Modulation analysis	EVM
MS-18.1	MS transmitter relative constellation error	Modulation analysis	EVM
MS-19.1	MS transmit synchronization	Modulation analysis	EVM
MS-20.1	MS transmit/receive switching gap	Modulation analysis (PER not included)	EVM (PER not included)
MS-24.2	MS transmit collaborative MIMO	Modulation analysis	EVM
MS-25.2	MS transmit beamforming support	Subchannel rotation on/off analysis supported (PER not included)	EVM (PER not included)

RF Transmitter Tests (continued)

Table 2. Required mobile station transmitter measurements and the corresponding measurements in N9075EM0D per WiMAX Forum Mobile Radio Requirement Testing Draft-T25-005-R010v03-B.

RCT test #	Transmitter test	Band class	Measurement/support in N9075EM0D
2.1.1.2.1	MS transmitter spectral mask	1.B	SEM measurement per tables 6, 7 of 2.1.1.2.1.6
2.1.1.2.2	MS transmitter spurious emission (conducted)	1.B	Spurious emission per procedure 2.1.1.2.2.6
2.1.1.3.1	MS transmitter spectral mask	3.A	SEM measurement per tables 16, 17 of 2.1.3.1.1.6
2.1.3.1.2	MS transmitter spurious emission (conducted)	3.A	Spurious emission per procedure 2.1.3.1.2.6.1, 2.1.3.1.2.6.2, and 2.1.3.1.2.6.3
2.1.5.1.1	MS transmitter spectral mask	5.A	SEM measurement per tables 38, 39, 40 of 2.1.5.1.5
2.1.1.2.2	MS transmitter spurious emission (conducted)	5.A	Spurious emission per procedure 2.1.5.2.6

Table 3. Required base station transmitter measurements and the corresponding measurements in N9075EM0D and 89600 VSA software per WiMAX Forum Mobile Radio Conformance Tests Release 1.0 Revision 2.1.0.

RCT test #	Transmitter test	N9075EM0D 802.16 OFDMA measurement (WiMAX/ WiBro)	89601B-B7Y 89601B for mobile and fixed WiMAX
BS-07.1	BS transmitter modulation and coding	Modulation analysis	EVM
BS-08.1	BS transmitter cyclic prefix, symbol timing, and frame duration timing	Modulation analysis	EVM
BS-09.1	BS transmit preambles	Modulation analysis	EVM
BS-10.1	BS transmitter power range	Channel power	Can be performed using band power markers
BS-11.1	BS transmitter spectral flatness	Modulation analysis	EVM
BS-12.1	BS transmitter relative constellation error	Modulation analysis	EVM
BS-13.1	BS synchronization	Modulation analysis	EVM
BS-16.1	BS receive/transmit switching gaps	Modulation analysis (PER not included)	EVM (PER not included)
BS-17.2	BS AMC receive and transmit operation	Modulation analysis	EVM
BS-19.2	BS transmit MIMO processing	Modulation analysis (PER not included)	EVM (PER not included)
BS-20.2	BS transmitter beamforming	Modulation analysis (MSE not included)	EVM (MSE not included)

Measurement details

All of the RF transmitter measurements as defined by the IEEE 802.16e standard, as well as a wide range of additional measurements and analysis tools, are available with a single keystroke. These measurements are fully remote controllable via the IEC/IEEE bus or LAN, using SCPI commands. A detailed list of supported measurements is shown in Table 4.

Table 4. One-button measurements provided by the N9075EM0D measurement application.

X-Series measurement application	N9075EM0D
Channel power	●
Adjacent channel power (ACP)	●
Spectrum emission mask (SEM)	●
Spurious Emission	●
Occupied bandwidth (OBW)	●
Power vs time	●
Power Statistic CCDF	●
Monitor spectrum	●
IQ waveform	●
Modulation analysis	●
RCE (EVM) peak, rms	●
Pilot RCE	●
Unmodulated RCE	●
Preamble RCE	●
RSSI	●
Preamble boosting	●
Preamble errors (phase)	●
Preamble PCINR R1, R3	●
Frequency error	●
IQ offset	●
IQ timing skew	●
IQ quad error	●
IQ gain imbalance	●
Subcarrier flatness (relative, absolute)	●
Symbol clock error	●
Sync correlation	●
Time offset	●
Constellation	●
Data burst list and map display	●
Symbol error vs subcarrier, vs symbol	●
Symbol power vs subcarrier, vs symbol	●

Key Specifications

Definitions

- Specifications describe the performance of parameters covered by the product warranty.
- 95th percentile values indicate the breadth of the population (≈2σ) of performance tolerances expected to be met in 95% of cases with a 95% confidence. These values are not covered by the product warranty.
- Typical values are designated with the abbreviation "typ." These are performance beyond specification that 80% of the units exhibit with a 95% confidence. These values are not covered by the product warranty.
- Nominal values are designated with the abbreviation "nom." These values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- PXA specifications apply to analyzers with frequency options of 526 and lower. For analyzers with higher frequency options, specifications are not warranted but performance will nominally be close to that shown in this section.

Note: Data subject to change

Supported devices and radio bands

Device type	Standard
BS, MS	802.16e-2005

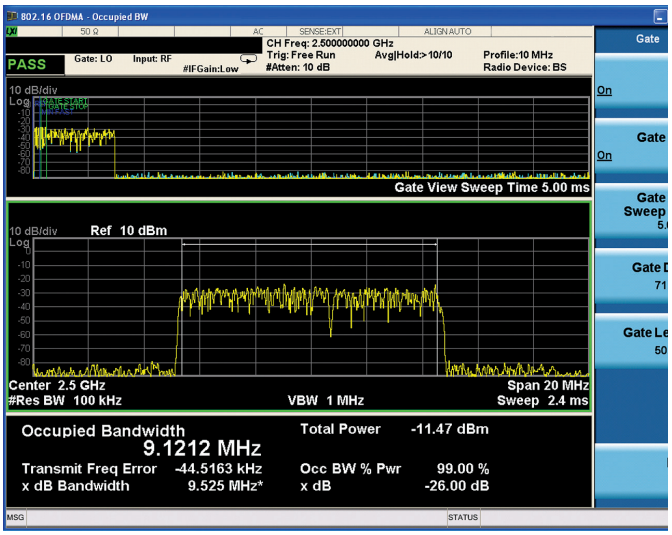


Figure 1. Time-gated occupied bandwidth measurement.

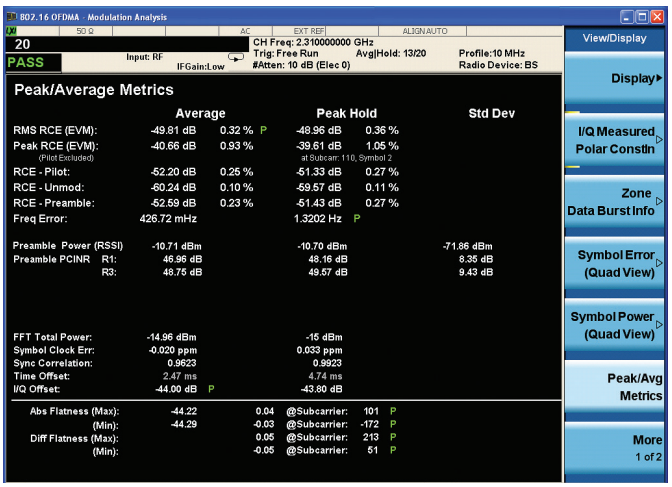


Figure 2. Modulation analysis results and metrics.

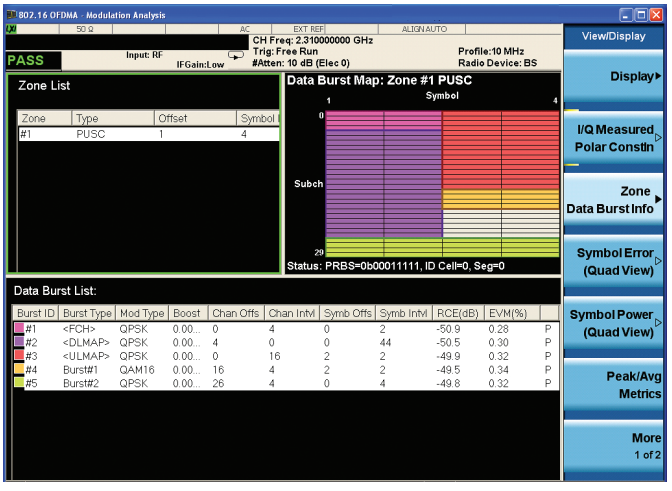


Figure 3. Modulation analysis views and auto-detected DL-MAP.

Performance Specifications

Description	PXA	MXA	EXA	CXA
Modulation analysis				
RCE (EVM) floor, RF input				
10 MHz BW profile				
CF ≤ 3 GHz	–50 dB	–49 dB[1]		–37.6 dB
3 GHz < CF < 3.6 GHz	–50 dB (nom)	–49 dB (nom)[1]	–42 dB (nom)	
RCE (EVM) floor, analog baseband IQ input				
10 MHz BW profile		–48 dB (nom)		
Adjacent channel power accuracy				
MS				
10 MHz offset	± 0.14 dB	± 0.16 dB	± 0.17 dB	± 0.42 dB
20 MHz offset	± 0.26 dB	± 0.47 dB	± 0.83 dB	± 1.78 dB
BS				
10 MHz offset	± 0.17 dB	± 0.60 dB	± 1.22 dB	± 2.14 dB
20 MHz offset	± 0.33 dB	± 0.64 dB	± 1.33 dB	± 2.63 dB
Channel power				
Minimum power at RF input	–35 dBm (nom)	–35 dBm (nom)	–35 dBm (nom)	–35 dBm (nom)
Absolute power accuracy 20 to 30 °C, Attenuation = 10 dB	± 0.63 dB	± 0.82 dB	± 0.94 dB	± 1.33 dB
90% confidence absolute power accuracy 20 to 30 °C, Attenuation = 10 dB	± 0.19 dB	± 0.23 dB	± 0.27 dB	± 0.61 dB
Measurement floor	–81.7 dBm (nom) at 10 MHz BW	–79.7 dBm (nom) at 10 MHz BW	–75.7 dBm (nom) at 10 MHz BW	–72.7 dBm (nom) at 10 MHz BW
Spectrum emission mask				
Dynamic range, relative	82.5	77.4	72.3	69.3
5.05 MHz offset 10 MHz BW	85.4 (typ)	82.8 (typ)	78.8 (typ)	75.5 (typ)
Sensitivity, absolute	–98.5 dBm	–94.5 dBm	–89.5 dBm	–86.5 dBm
5.05 MHz offset 10 MHz BW	(–101.5 dBm typ)	(–99.5 dBm typ)	(–95.5 dBm typ)	(–92.5 dBm typ)
Accuracy				
Relative	± 0.05 dB	± 0.12 dB	± 0.11 dB	± 0. 28 dB
Absolute 20 to 30 °C	± 0.62 dB (± 0.20 dB 95% confidence)	± 0.88 dB (± 0.27 dB 95% confidence)	±1.05 dB (± 0.31 dB 95% confidence)	± 1.53 dB (± 0.65 dB 95% confidence)
Spurious emissions				
Accuracy				
Frequency range				
20 Hz to 3.6 GHz	± 0.19 dB (95% confidence)	± 0.29 dB (95% confidence)	± 0.38 dB (95% confidence)	± 0.81 dB (95% confidence, 100 kHz to 3 GHz)
3.5 to 8.4 GHz	± 1.08 dB (95% confidence)	± 1.17 dB (95% confidence)	± 1.22 dB (95% confidence)	± 1.80 dB (95% confidence, 3 to 7.5 GHz)
8.3 to 13.6 GHz	± 1.48 dB (95% confidence)	± 1.54 dB (95% confidence)	± 1.59 dB (95% confidence)	NA

1. For instruments with serial number prefix ≥ MY/SG/US5233, which ship standard with N9020A-EP2 as the identifier. Refer to the 802.16 OFDM chapter of the MXA specification guide for specifications on the other MXAs. For MXA, phase noise optimization is set to fast tuning.

For a complete list of specifications refer to the appropriate specifications guide.

Benchtop:
PXA: www.keysight.com/find/pxa_specifications
MXA: www.keysight.com/find/mxa_specifications
EXA: www.keysight.com/find/exa_specifications
CXA: www.keysight.com/find/cxa_specifications

PXIe:
VXT: www.keysight.com/find/m9421a

Ordering Information

Flexible licensing and configuration

- **Perpetual:** License can be used in perpetuity.
- **Time-based:** License is time limited to a defined period, such as 12-months.
- **Node-locked:** Allows you to use the license on one specified instrument/computer.
- **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
- **USB portable:** Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
- **Software support subscription:** Allows the license holder access to Keysight technical support and all software upgrades

You Can Upgrade!

All of our X-Series application options are license-key upgradeable.

UP GRADE

Mobile WiMAX measurement application (N9075EM0D)

Model	Software License Type	Support Contract	Support Subscription (12-month) [2]
N9075EM0D-1FP	Node-locked perpetual	R-Y5C-001-A[2]	R-Y6C-001-L[2]
N9075EM0D-1FL	Node-locked 12-month	R-Y4C-001-L[1]	Included
N9075EM0D-1TP	Transportable perpetual	R-Y5C-004-D[2]	R-Y6C-004-L[2]
N9075EM0D-1TL	Transportable 12-month	R-Y4C-004-L[1]	Included
N9075EM0D-1NP	Floating perpetual	R-Y5C-002-B[2]	R-Y6C-002-L[2]
N9075EM0D-1NL	Floating 12-month	R-Y4C-002-L[1]	Included
N9075EM0D-1UP	USB portable perpetual	R-Y5C-005-E[2]	R-Y6C-005-L[2]
N9075EM0D-1UL	USB portable 12-month	R-Y4C-005-L[1]	Included

One month software support subscription extensions [3]

Model	Description
R-Y6C-501[3]	1-month of software support subscription for node-locked license
R-Y6C-502[3]	1-month of software support subscription for floating license
R-Y6C-504[3]	1-month of software support subscription for transportable license
R-Y6C-505[3]	1-month of software support subscription for USB portable license

1. All time-based X-Series measurement application licenses includes a 12-month support contract which also includes the 12-month software support subscription as same duration.
2. Support contract must bundle software support subscription for all perpetual licenses in the first year. All software upgrades and Keysight support are provided for software licenses with valid support subscription.
3. After the first year, software support subscription may be extended with annual or monthly software support subscription extensions for perpetual licenses.

Try Before You Buy!

Evaluate a full-featured version of our X-Series measurement application with our ***FREE*** trial. Redeem one 30-day trial license of each measurement application online at: www.keysight.com/find/X-Series_apps_trial

Hardware Configurations

To learn more about compatible platforms and required configurations, please visit: www.keysight.com/find/X-Series_apps_platform

Software Models & Options

To learn more about X-Series measurement application licensing, model numbers and options, please visit: www.keysight.com/find/X-Series_apps_model

Hardware Configuration

For optimizing the Mobile WiMAX measurement application, Keysight recommends a minimum level of instrument hardware functionality at each instrument performance point. Supported instruments include:

Benchtop:
- PXA N9030A
- MXA N9020A
- EXA N9010A
- CXA N9000A

PXIe:
- VXT M9420/21A

N90x0A X-Series signal analyzer

Capability	Instrument Option	Benefit
Analysis bandwidth	10 or 25 MHz as default or higher	**Required**: Wider analysis bandwidth options such as 25/40/85/160 MHz can be selected depending on the specified signal analyzer model
Precision frequency reference	-PFR	**Recommended**: For enhanced frequency accuracy and repeatability for lower measurement uncertainty
Electronic attenuator	-EA3	**Recommended**: Fast and reliable attenuation changes ideal for manufacturing without the wear associated with mechanical attenuators up to 3.6 GHz in 1 dB steps
Pre-amplifier	3.6 GHz (-P03) or higher	**Recommended**: For maximizing the measurement sensitivity
Fine resolution step attenuator	-FSA	**Recommended**: Useful for maximizing useable dynamic range to see signals
Analog baseband I/Q inputs	-BBA on PXA and MXA only	**Optional**: To extend measurements at baseband if required by device under test

M9420/21A PXIe VXT vector transceiver

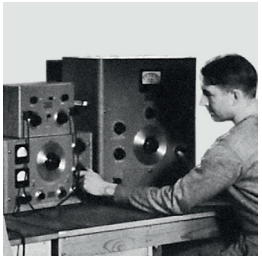
Description	Model-Option	Additional information
Frequency range 3.8 or 6 GHz	M9420A/M9421A-504, or 506	One required
Analysis bandwidth 40, 80 or 160 MHz	M9420A/M9421A-B40/B80/B1X	One required
Memory 256 or 512 MSa	M9420A/M9421A-M02/M05	One required
Half duplex port	M9420A/M9421A-HDX	Optional
High output power	M9420A/M9421A-1EA	Optional

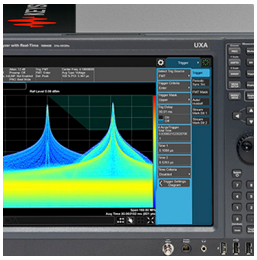
Related Literature

Description	Publication number
N9075A and W9075A, Demonstration Guide	5990-5930EN
Mobile WiMAXTM PHY Layer (RF) Operation and Measurement, Application Note	5989-8309EN
IEEE 802.16e WiMAX OFDMA Signal Measurements and Troubleshooting, Application Note 1578	5989-2382EN
N9075A & W9075A 802.16 OFDMA Measurement Application Measurement Guide	N9075-90013
User's and Programmer's Reference Guide is available in the library section of the N9075A and W9075A product pages.	

Evolving Since 1939

Our unique combination of hardware, software, services, and people can help you reach your next breakthrough. We are unlocking the future of technology.
From Hewlett-Packard to Agilent to Keysight.





myKeysight

myKeysight
www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

http://www.keysight.com/find/emt_product_registration
Register your products to get up-to-date product information and find warranty information.

KEYSIGHT SERVICES
Accelerate Technology Adoption.
Lower costs.

Keysight Services
www.keysight.com/find/service
Keysight Services can help from acquisition to renewal across your instrument's lifecycle. Our comprehensive service offerings—one-stop calibration, repair, asset management, technology refresh, consulting, training and more—helps you improve product quality and lower costs.

CALIBRATION WARRANTY UP TO 10 YEARS
ASSURANCE PLANS

Keysight Assurance Plans
www.keysight.com/find/AssurancePlans
Up to ten years of protection and no budgetary surprises to ensure your instruments are operating to specification, so you can rely on accurate measurements.

Keysight Channel Partners
www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

www.keysight.com/find/X-Series_apps
www.keysight.com/find/N9075D

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 11 2626
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

Europe & Middle East

Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	800 000154
Sweden	0200 882255
Switzerland	0800 805353 Opt. 1 (DE) Opt. 2 (FR) Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-9-7-17)

DEKRA Certified
ISO9001 Quality Management System

www.keysight.com/go/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2015
Quality Management System

KEYSIGHT TECHNOLOGIES

Published in USA, April 6, 2018
5992-2927EN
www.keysight.com